# Circulation and Hydrography of the Northeastern Chukchi Sea in Summer Peigen Lin\*, Robert S. Pickart, Leah McRaven Woods Hole Oceanographic Institution

### 1. Motivation

Many aspects of the circulation over the northeastern Chukchi shelf, its sensitivity to wind, and its impact on water mass distribution remain uncertain. In addition, links to the biological activity on this part of the shelf need to be further explored.



Figure 1. (a) Schematic circulation of the Chukchi Sea (Corlett and Pickart, 2017). (b) The study region on the northeast Chukchi Shelf divided into four sub-regions I, II, III and IV progressing clockwise around Hanna shoal.

# 2. Data and Methods

• CTD, nutrient, and shipboard ADCP data from 8 synoptic cruises on the northeast Chukchi shelf spanning the time period 2003 – 2017.

Cruise	Ship	Year	Date	Season
NBP03	R/V N.B. Palmer	2003	Jul 09 – Aug 17	Summer
HLY03	USCGC Healy	2003	Sep 14 – Oct 17	Fall
HLY04	USCGC Healy	2004	Sep 7 – Sep 30	Fall
HLY10	USCGC Healy	2010	Jun 18 – Jul 16	Summer
HLY11	USCGC Healy	2011	Jun 28 – Jul 24	Summer
HLY1401	USCGC Healy	2014	May 15 – Jun 20	Spring - Summer
HLY1402	USCGC Healy	2014	Jul 09 – Jul 25	Summer
HLY17	USCGC Healy	2017	Aug 26 – Sep 15	Summer - Fall

- Historical hydrographic data from the Pacific Marine Arctic Regional Synthesis (PacMARS) from 1981 – 2013.
- End-member analysis to define the water masses.



Figure 2. T-S diagram with all data (grey dots) and near-bottom measurements (red dots). ACW = Alaskan Coastal Water; *WW = Pacific Winter Water;* MWR = Meltwater / River runoff.

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## 3. Progression and evolution of water masses a. Shelf-wide distributions



Figure 3. Monthly evolution of the near-bottom water masses in the Chukchi Sea.

### b. Bering Strait boundary condition

- The summer months are characterized by a minimum in Pacific Winter Water percentage and a maximum in Alaskan Coastal Water percentage.
- Southerly winds enhance the presence of Alaskan Coastal Water, while northerly winds reduce it.



Figure 4. Monthly mean Pacific Winter Water percentage (blue line) and Alaskan Coastal Water percentage (red line) near Bering Strait.

### c. Northeastern Chukchi Sea

- Pacific Winter Water fills the region in early summer, decreasing in presence clockwise around Hanna Shoal as the season progresses.
- The injection of Alaskan Coastal Water into the region mirrors this pattern.



Figure 5. Monthly evolution of water mass percentage near the bottom: Pacific Winter Water (top row) and Alaskan Coastal Water (bottom row).

- Alaskan Coastal Water is advected predominantly by the Alaskan Coastal Current towards Barrow Canyon. Its presence on the shelf peaks in September.
- Bering Summer Water is commonly found in the Central Channel pathway, progressing around Hanna Shoal and displacing Pacific Winter Water.

# 4. Circulation in northeastern Chukchi Sea

- northward.

- Current and Beaufort Shelfbreak Jet.

![](_page_0_Figure_37.jpeg)

ADCP data points are marked by the grey dots.

# 5. Physical-biological links

- Coastal Water above Pacific Winter Water.
- The winter water was generally high in nitrate.

![](_page_0_Figure_43.jpeg)

![](_page_0_Picture_44.jpeg)

![](_page_0_Picture_47.jpeg)

• The Central Channel branch bifurcates near 71.5°N as it flows

• The two branches (cyclonic and anti-cyclonic) recombine southeast of Hanna Shoal and merge with the Alaskan Coastal Current. • These patterns are consistent with the water mass distributions. • The outflow from Barrow Canyon feeds both the Chukchi Slope

> Figure 6. Gridded vertically-averaged circulation in the northeastern Chukchi Sea during weak wind conditions, using data from the 8 synoptic surveys. The original

• A late-summer 2017 cruise extensively sampled the northeast Chukchi Shelf, which displayed a two-layer structure: Alaskan

• The high-nutrient water extended higher into the water column in region III, a known location of increased biological activity. The historical data also indicate higher nitrate in this region.

> Figure 7. (a) Stations occupied during cruise HLY17 (black dots). The red circles mark the stations used in the bottom panel. (b) Percentage of Pacific Winter Water (color) and nitrate concentration (circles) progressing around Hanna Shoal, following the red dots in the top panel.

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